

Claims

- [c1] A method of manufacturing a deep trench capacitor structure, said method comprising:
 - forming a trench in a substrate;
 - forming titanium nitride columns in said trench;
 - dry etching said titanium nitride columns using halogen-based gas phase chemistry that is substantially isotropic to remove an upper portion of said titanium nitride columns without affecting surrounding materials; and
 - filling a space between said titanium nitride columns and said upper portion of said trench with polysilicon material.
- [c2] The method in claim 1, wherein said process of filling said space simultaneously forms a polysilicon plug and polysilicon cap.
- [c3] The method in claim 1, wherein said halogen-based chemistry is substantially fluorine free.
- [c4] The method in claim 1, wherein said halogen-based chemistry has less than 5% fluorine.
- [c5] The method in claim 1, wherein said etching process comprises using a decoupled power source that is sub-

stantially free of bias.

- [c6] The method in claim 1, wherein said etching process comprises using a decoupled power source with a bias power of less than 100 W.
- [c7] The method in claim 1, wherein said etching process is substantially ion-free.
- [c8] A method of manufacturing a trench capacitor structure, said method comprising:
 - forming titanium nitride columns in a trench ;
 - etching said titanium nitride columns using halogen-based chemistry that is substantially ion free to remove an upper portion of said titanium nitride; and
 - filling a space between said titanium nitride columns and said upper portion of said trench with polysilicon material.
- [c9] The method in claim 8, wherein said process of filling said space simultaneously forms a polysilicon plug and polysilicon cap.
- [c10] The method in claim 8, wherein said halogen-based chemistry is substantially fluorine free.
- [c11] The method in claim 8, wherein said halogen-based chemistry has less than 5% fluorine.

- [c12] The method in claim 8, wherein said etching process comprises using a decoupled power source that is substantially free of bias.
- [c13] The method in claim 8, wherein said etching process comprises using a decoupled power source with a bias power of less than 100 W.
- [c14] The method in claim 8, wherein said etching process is substantially isotropic.
- [c15] A method of manufacturing a deep trench capacitor structure, said method comprising:
forming a trench in a substrate;
lining said trench with a polysilicon liner;
forming titanium nitride columns along said polysilicon liner;
dry etching said titanium nitride columns using halogen-based chemistry that is substantially isotropic to remove an upper portion of said titanium nitride columns without affecting said polysilicon liner, wherein said etching process attacks only in the uppermost portion of said titanium nitride columns such that, after said etching process is completed, the remaining lower portions of said titanium nitride columns are substantially unaffected by said etching process; and

filling a space between said titanium nitride columns and said upper portion of said trench with additional polysilicon material.

- [c16] The method in claim 15, wherein said process of filling said space simultaneously forms a polysilicon plug and polysilicon cap.
- [c17] The method in claim 15, wherein said halogen-based chemistry is substantially fluorine free.
- [c18] The method in claim 15, wherein said halogen-based chemistry has less than 5% fluorine.
- [c19] The method in claim 15, wherein said etching process comprises using a decoupled power source that is substantially free of bias.
- [c20] The method in claim 15, wherein said etching process comprises using a decoupled power source with a bias power of less than 100 W.
- [c21] The method in claim 15, wherein said etching process is substantially ion-free.
- [c22] A method of manufacturing a deep trench capacitor structure, said method comprising:
 - forming a trench in a substrate;
 - lining said trench with a polysilicon liner;

forming titanium nitride columns along said polysilicon liner;

dry etching said titanium nitride columns using halogen-based chemistry that is substantially ion free to remove an upper portion of said titanium nitride columns without affecting said polysilicon liner, wherein said halogen-based chemistry comprises 5%–95% chlorine-type reactants and less than 5% fluorine-type reactants; and filling a space between said titanium nitride columns and said upper portion of said trench with additional polysilicon material.

[c23] The method in claim 22, wherein said process of filling said space simultaneously forms a polysilicon plug and polysilicon cap.

[c24] The method in claim 22, wherein said etching process comprises using a decoupled power source that is substantially free of bias.

[c25] The method in claim 22, wherein said etching process comprises using a decoupled power source with a bias power of less than 100 W.

[c26] The method in claim 22, wherein said etching process is substantially isotropic.